Challenge Team Status: MBSE and CubeSat

Space Systems Working Group
MBSE Challenge Team, 2011-12

Jet Propulsion Laboratory,
California Institute of Technology

2012 Team

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SSWG Challenge Team Status

- Cube Sat Modeling
  - CubeSat Framework
  - RAX Models
- CubeSat RAX Science Scenario
  - Issues with SysML Simple Time Model
  - Issues with SysML Instances
- STK Integration Demo Update
  - Model Transformation-Based SysML-STK Integration
- Model Based Reporting Demo
  - Model Based Document Generation

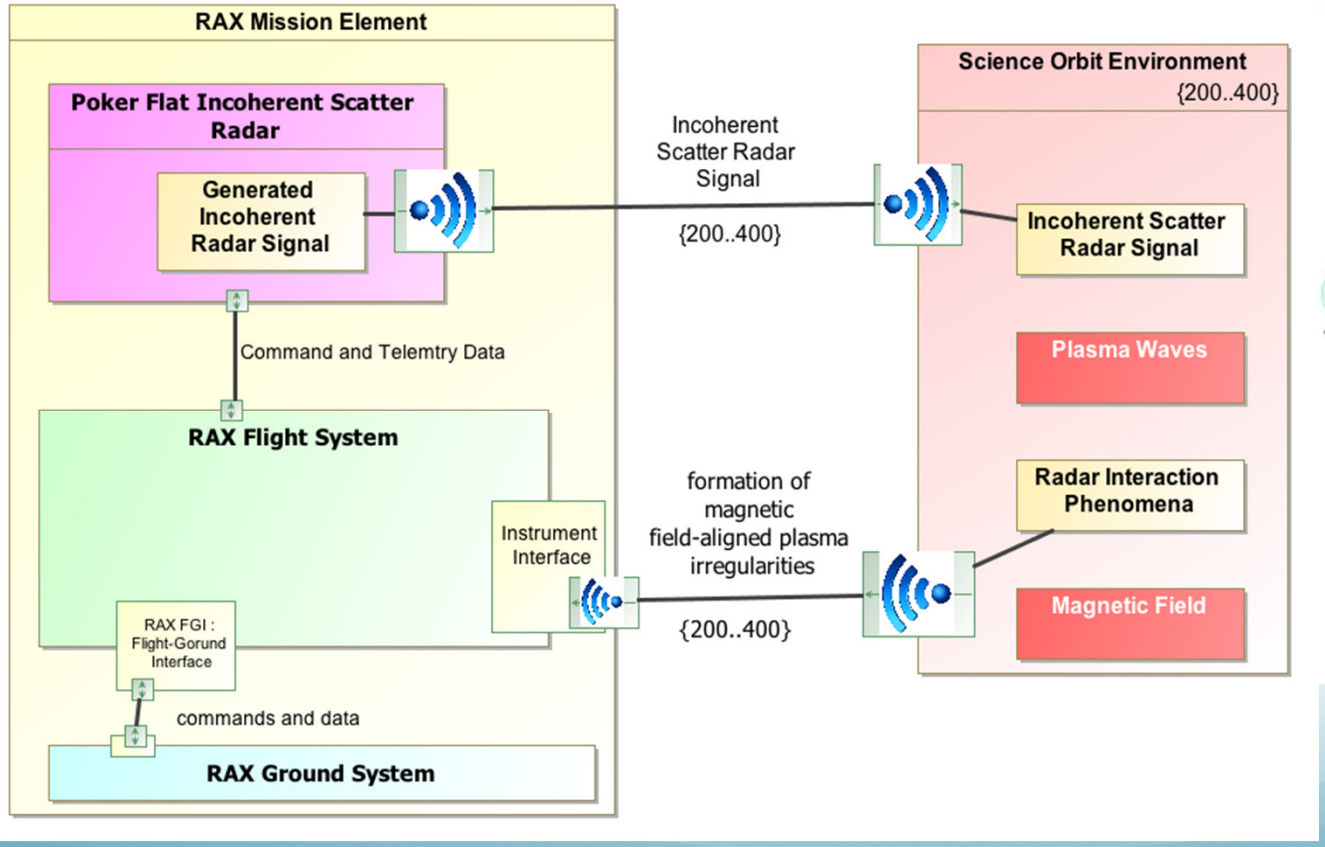
Objective:
Demonstrate Real-world Application of MBSE

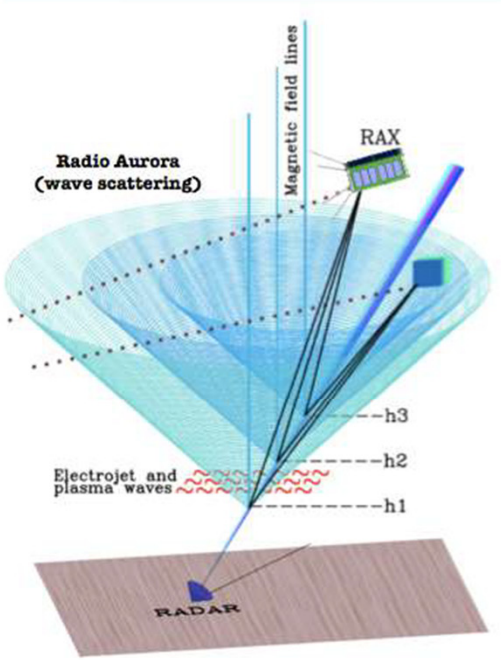
- 2007-11 FireSat Modeling Demonstrates MBSE Feasible for Space Systems
  - Basic SysML Modeling
  - Examples of Simulation Integration with STK
- 2012 – A Real Flight Project
  - RAX 2 (http://rax.engin.umich.edu/)
  - Develop MBSE Framework for CubeSats in SysML
    - Utilize MBSE Method and Techniques from FireSat
    - CubeSat Domain Specific Concepts
    - Integration Strategies for Analysis Apps
      - Satellite Tool Kit

NASA Jet Propulsion Laboratory MBSE

- Europa Habitability Mission
  - Europa Concept Modeling
  - Several Large Mission and Flight System Models
  - Models used as basis for some key analyses
  - Generated Documents from Models as deliverable products
- MGSS Ops Revitalization
  - Process Models
  - System Interfaces
  - Ops Spacecraft Models

RAX Mission Science

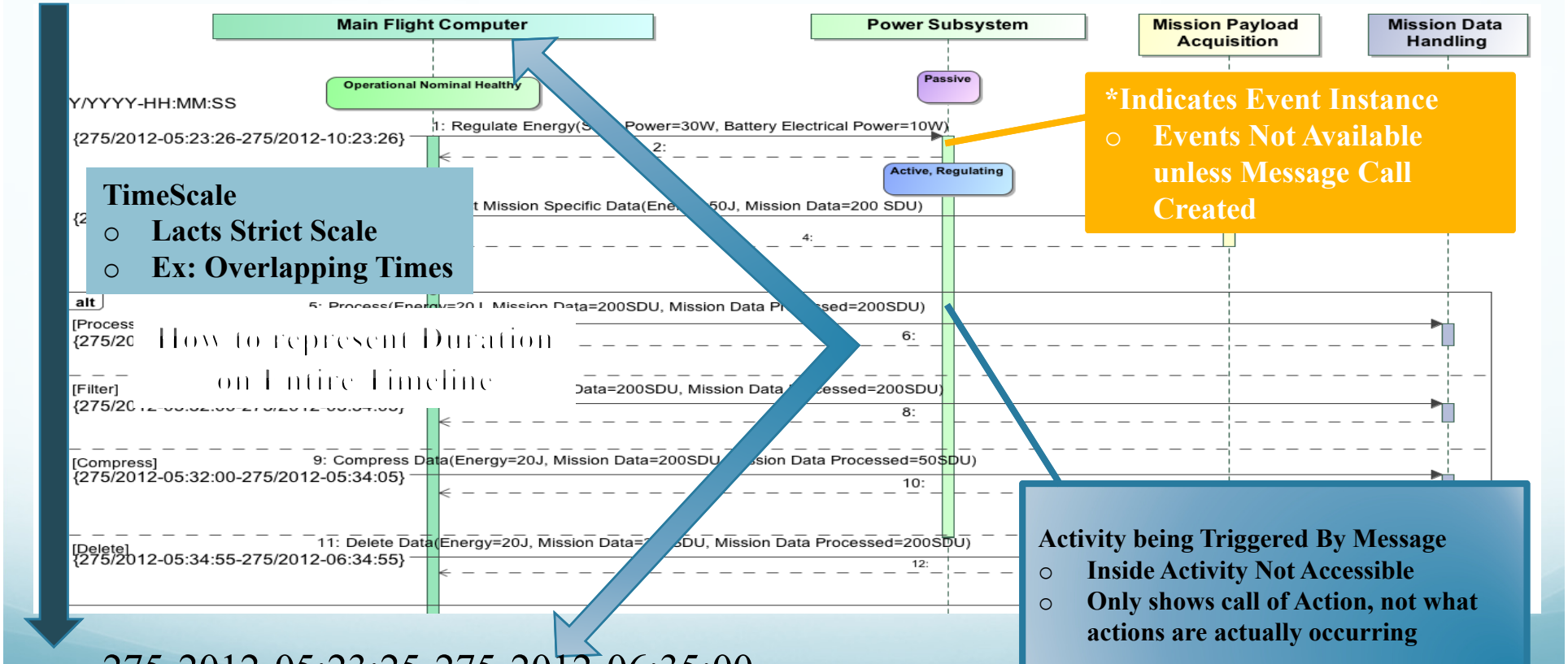




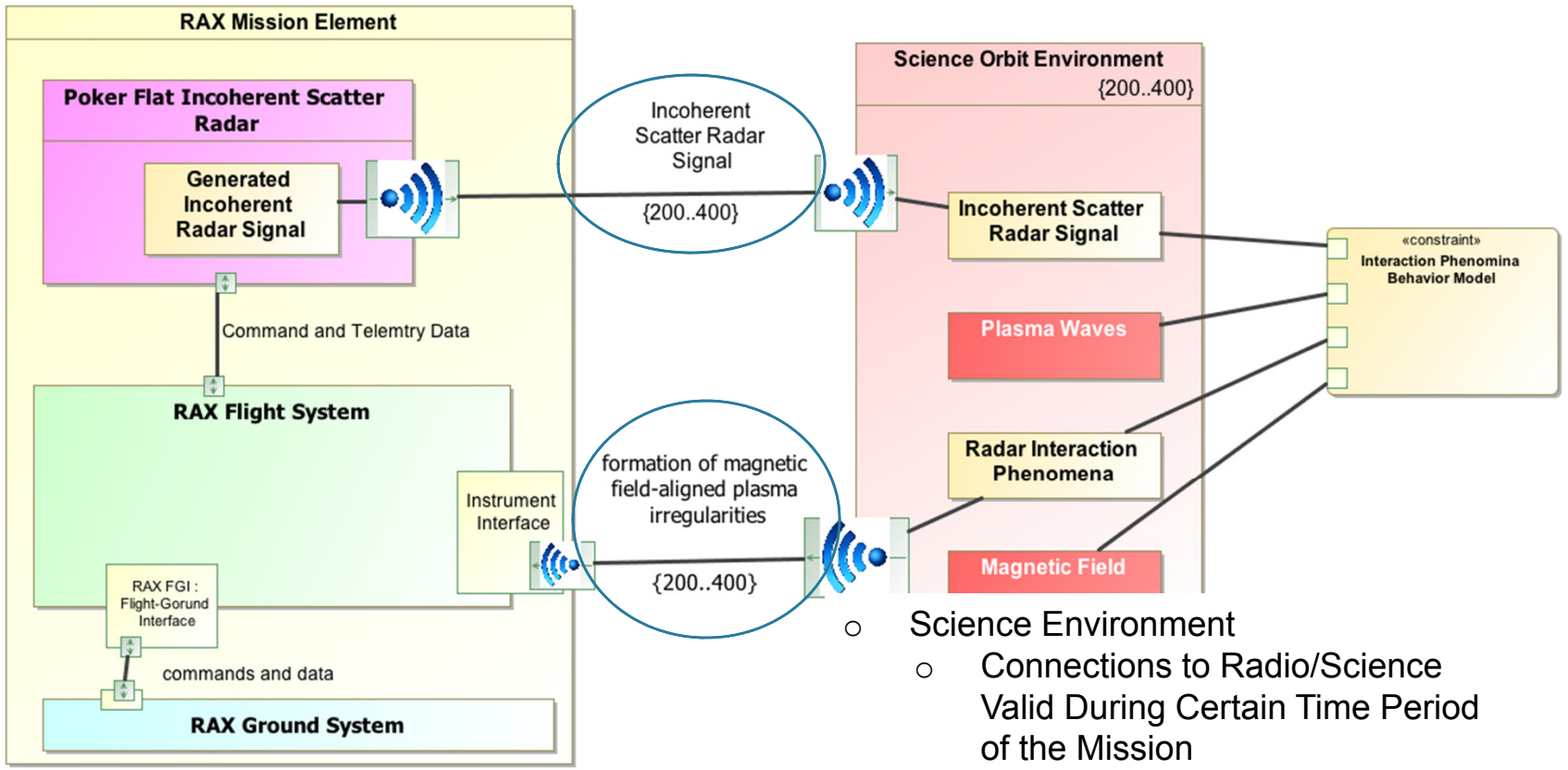
Challenges with Modeling Time

- Time Domain Modeling, Time Scales and Time Systems
  - No General Model for the “Lifetime” of the System
- Application and Specificity of Temporal Constraints
- Using Instances to Describe Operational System in terms of Structure, Behavior and Time
  - Understanding of Structure and Behavior in a Unified Temporal Context
  - Time-Sequences of Instance Values
  - Sequence Diagram of Value Property Instances
  - No good instance model for behaviors

Challenges with Modeling Time

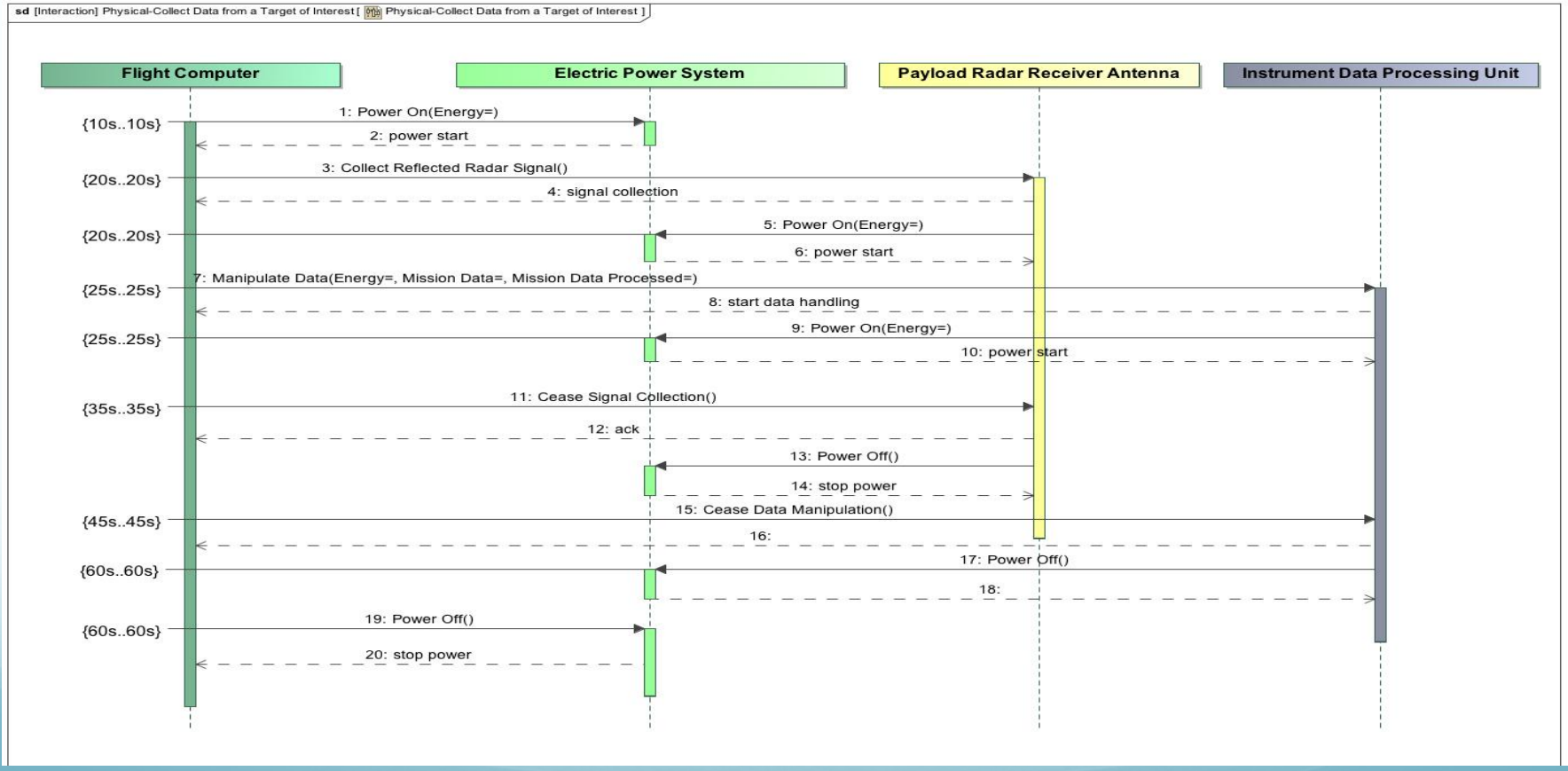


Rax Mission Time and Instance Example

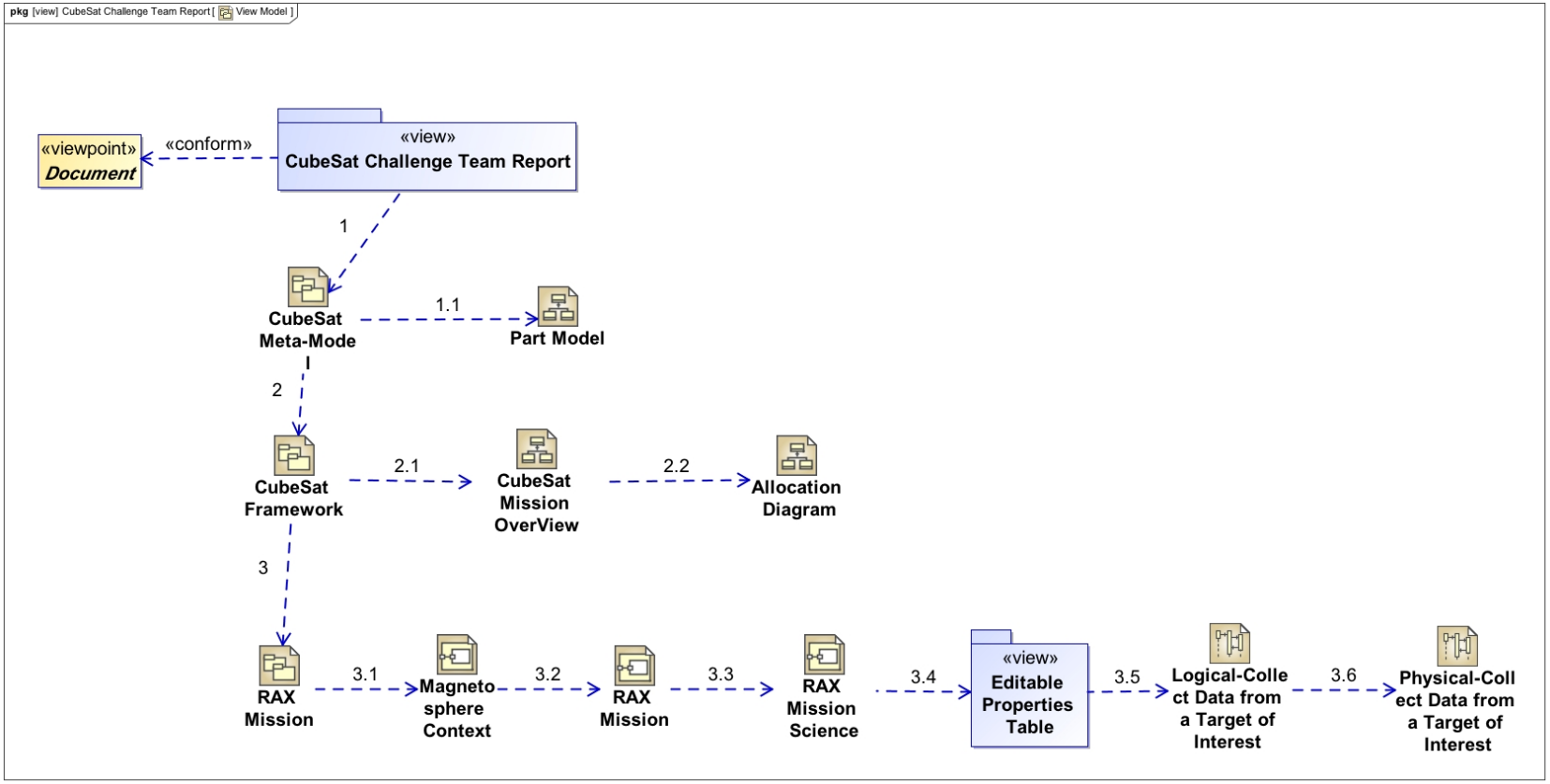


- Science Environment
  - Connections to Radio/Science Valid During Certain Time Period of the Mission

STK Integration Example



Model Based Reporting



SSWG Challenge Team: Next Steps

- Elaborate CubeSat Framework and RAX Instance
- Use CubeSat Framework and Missions
  - Drive out issues with SysML Simple Time Model
  - Drive out issues with SysML Instance Modeling
- Demonstrate Reference Architecture for MBSE Platform
  - Model Based Analysis
  - Model Based Reporting (Document Generation)
- Explore CubeSat Mission as Demonstrator
- Propose a CubeSat Mission using the framework